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ANNUAL SUMMARY

PART C

STORMS AND DEPRESSIONS

CONTENTS

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PART C

STORMS AND DEPRESSIONS

I. DEPRESSIONS AND CYCLONIC STORMS

During the year, 2 cyclonic storms and one depression formed in the Arabian Sea, 2 cyclonic storms and 9 depressions in the Bay of Bengal, and one land depression over Eastern Pakistan. The dates of activity of the storms and the greatest barometric depths observed near their centres are summarised in the following table :—

TABLE 1

Locality	Month	Date	Greatest observed barometric depth
Arabian Sea	April	15th-24th	14 mb.
Bay of Bengal	July	24th-29th	14 mb.
Arabian Sea	November	12th-19th	22 mb.
Bay of Bengal	December	5th-14th	19 mb.

The detailed descriptions of these storms and depressions are followed by a list of western disturbances and the more important local storms, and of the localities in which winds of force 9 or more, unconnected with storms were experienced by ships in the Indian Seas.

1. Cyclonic storm in Arabian Sea from 15th to 24th April.—Following the westward movement of a low pressure wave from the southwest Bay of Bengal, a trough developed in the Southeast Arabian Sea over Comorin area and off Malabar coast by the 11th morning. The movement of the low pressure wave had caused widespread rain in the Peninsula to the south of Lat. 13°N. The trough shifted westwards and lay on the 12th morning to the west of Minicoy, with its axis along Long. 72°E., and its effect extended upto 15,000 ft. a.s.l. It became more active on the 14th and conditions were then markedly unsettled in the Laccadives-Maldives region and to its immediate west, as indicated by the upper winds at Male and Minicoy. In course of next 24 hours, the unsettled conditions concentrated into a depression, centred near Lat. 8°N. Long. 69°E. at 0830 hrs. I.S.T. of the 15th. Widespread rain continued in the Peninsula to the south of Lat. 13°N. until the morning of 14th, but decreased thereafter. The depression apparently slowly shifted northwestwards, but due to lack of observations from the affected sea areas during the next two days it is difficult to fix the centres with any degree of precision. By the 18th night, the depression became deep and was centred near Lat. 12°N. and Long. 63°E. The following ships' observations support this view:—

TABLE 2

Date	Time Hrs. IST	Name of Ship	Position		Wind		PPP (Bar.)	Weather
			Lat.	Long.	Dirn.	Vel.		
18th	1130	Esperance Bay	10·1°N.	66·0°E	180°	17K	1008·3	Cloud forming.
18th	1730	Ditto	10·4°N	64·7°E	180°	17K	1003·7	Cloud forming.
18th	2330	Ditto	10·8°N	63·3°E	220°	27K	1004·6	Shower in last hour.
18th	1730	Empire Halladale	9·6°N	64·6 E	200°	18K	1004·6	Moderate shower
8th	2330	Ditto	9·7°N	63·6°E	240°	22K	1006·0	Partly cloudy.

The deep depression moved in a westnorthwesterly direction and intensified into a cyclonic storm centred near Lat. 13°N. and Long. 61°E. at 1730 hrs. I.S.T. of 19th. The following observations from ships are significant:—

TABLE 3

Date	Time Hrs. IST	Name of Ship	Position		Wind		PPP (Bar.)	Weather
			Lat.	Long.	Dirn.	Vel.		
19th . .	1730	Esperance Bay . .	11·6°N	60·2°E	270°	32K	999·2	Clouds forming (rain).
19th . .	1730	Spring . . .	10·1°N	60·3°E	270°	35K	998·3	Frequent rainsqualls.
19th . .	1730	Malampur . .	9·5°N	63·2°E	250°	Strong	999·6	Bar. falling; rough sea and heavy swell.

The cyclonic storm moved in a northwesterly direction, but had apparently weakened later into a deep depression which was centred near Lat. 14°N., Long. 59°E. at 2330 hrs. I.S.T. of the 20th. Thereafter, it moved very slowly and weakening gradually lay as a depression with centre near Lat. 15°N and Long 58°E at 1730 hrs. I.S.T. of 22nd. An extract from the log of S. S. Canton which passed close to the centre of the deep depression at 1200 G.M.T. of 22nd is reproduced below:—

TABLE 4

Date	Time Hrs. IST	Position		Wind		PPP (Bar.)	Weather	Cloud
		Lat.	Long.	Dirn.	Vel.			
22nd .	0530	14°53′N	55°35′E	330°	3 BF	1004·7	Drizzle	5/8 Cb. base 3000′ 1/8Ac.
22nd .	1130	15°18′	57°26′	020°	5 BF	1005·3	Squall, passing showers .	5/8 Cb. base 2000′.
22nd .	1730	15°40′	59°05′	090°	7 BF	999·0	Squall	8/8 Cb. base 1500′.
22nd .	2330	16°08′	60°57′	170°	6 BF	1006·2	Drizzle, rain, squall. .	5/8 Cb. base 1500′ 2/8Ac.

In the course of the following 24 hours, the depression weakened rapidly and, by the evening of the 23rd, it lay as a trough off South Kuria Muria Coast and Socotra. By the next morning, the trough became unimportant.

2. Shallow depression in the Bay of Bengal—4th-5th June.—By the 1st June, the monsoon had advanced into the south Bay and was advancing into the east central Bay of Bengal. In association with the above a region of marked pressure fall extended from the southwest to the central parts of the Bay. Large negative pressure departures over the Tenasserim coast and northwesterly upper winds at Port Blair together with southerly winds at Victoria Point suggested that a low pressure wave was moving westwards across the Tenasserim coast on the 1st. Its entry into the Bay helped the monsoon to strengthen over the southeast Bay of Bengal causing 3″ of rain at Port Blair and 4″ at Victoria Point by the 2nd morning. A cyclonic circulation was developing over the north and central Bay of Bengal between 5,000 and 10,000 ft. a.s.l. on that day. By the 3rd morning, the cyclonic circulation became well-marked even in the lower levels showing that conditions had become unsettled in the west central Bay and adjoining areas. On the 4th morning, the cyclonic circulation became more pronounced over the west central and the northwest Bay, indicating that a shallow depression was forming with its central region near Lat. 18°N., Long. 88°E. The depression remained practically stationary till the evening of 4th. Thereafter it moved westnorthwestwards and was centred near Lat. 18½°N., Long. 86½°E. on the morning of 5th, when it was weakening. It passed inland as a low pressure wave across the Orissa coast on the same afternoon and became unimportant by the next day.

The depression helped the monsoon to get established over the Bay and advance into Orissa, West Bengal, Chota Nagpur and Bihar on the 4th, and into Assam by the next day.

3. Depression in the Arabian Sea—11th-13th June.—A trough of low pressure appeared in the east central Arabian Sea on the 7th morning. The upper winds along the north Konkan-Kathiawar coast, which were westerly on the previous day, had also by then become southerly upto 3,000 ft. a.s.l. Pressures started falling along the Konkan-Kathiawar coast by the 8th morning, and large negative pressure departures appeared over the coast and the adjoining sea area, indicating that the trough was deepening. The upper winds along the north Konkan and Kathiawar coasts had strengthened considerably and become more cyclonic by the 10th morning. By then, the 'departure low' had also become more pronounced, Veraval showing a negative departure of 7·7 mbs. The conditions had thus become markedly unsettled in the Arabian Sea off the Konkan-Kathiawar coast. On the 11th the 0230 hrs. I.S.T. upper winds over Bombay and Veraval at 5,000 ft. a.s.l. were SSW 29 Knots and ESE 43 Knots respectively. From these observations it could be inferred that the trough had concentrated into a depression by the early hours of the 11th. The depression was centred at 0830 hrs. I.S.T. of this day near Lat. 19°N., Long. 68°E. and was practically stationary till the evening of the 11th. It then moved northwestwards and was centred on the 12th morning near Lat. 21°N., Long. 67°E. However, by the same evening, the depression weakened into a trough off the Sind-Kathiawar coast. Apparently, the initial deepening and the weakening later of the 'low' was associated with the movement eastwards of a wave trough in the upper westerlies across the north Arabian Sea.

In association with the formation and movement of the above depression, the monsoon was generally vigorous along the west coast, south of Ratnagiri, between the 9th and 13th. The monsoon advanced into the north Konkan by the 12th. It also extended feebly into north Deccan (Desh) on the same date, and into Saurashtra and south Gujarat by the next day. S. S. Maharashmi, a 1600 ton coastal cargo vessel, ran aground near Bhatkal on 10th on account apparently of the squally weather prevailing along the coast.

Some particularly heavy rainfall amounts caused in association with the depression are given below:—

TABLE 5

Date	Station	Rainfall
10th June	Vengurla	6″
	Marmagao	5″
11th June	Savantwadi	7·4″
	Kankavli	10″
12th June	Guhagar	10·1″
	Savantwadi	8·9″
	Vengurla	8·6″
	Harnai	9·2″
	Chiplun	7″
	Kudal	7·1″
	Devgad	6·9″
	Rajapur	5·9″

4. Depression in the Bay of Bengal—26th June-7th July.—A low pressure wave from the east was affecting upper Burma on the 22nd morning. It moved into the north Bay of Bengal by the 24th morning and caused the seasonal trough to extend into the northwest and adjoining west central Bay where a feeble upper air cyclonic circulation appeared between 5,000 ft. and 10,000 ft. a.s.l. On the 25th morning the upper air circulation became more marked, and a 'low' appeared also on the sea level chart over the northwest Bay. By the 26th morning, the low concentrated into a depression, centred near Lat. 20½°N., Long. 87½°E. The depression moved northwestwards and lay close to the coast near Balasore on the same afternoon. It crossed the coast during the night and weakened into a low pressure area, which lay over Chota Nagpur and adjoining northeast Madhya Pradesh on the morning of 27th. Moving slightly northwards, it lay over south Bihar and neighbourhood on the next morning. Thereafter, the low did not have an orderly displacement to justify its being treated as a depressional system. However, it did not fill up or merge with the seasonal low immediately and after persisting over south Bihar for a couple of days, shifted to east Uttar Pradesh where it stayed till the 2nd July, and finally filled up over south Bihar only by the 7th morning.

Under the influence of this depression, the monsoon caused locally heavy to very heavy rain along coastal Orissa on the 26th and 27th, Gopalpur having 6″ during the 9 hours ending at 1730 hrs. I.S.T. on the 26th. The monsoon extended into east Madhya Pradesh, Vindhya Pradesh and Madhya Bharat on the 27th, into east Uttar Pradesh on the 29th and into west Utter Pradesh and the Punjab (I) on the 1st July. The monsoon was vigorous in east Uttar Pradesh on the 30th and in Vindhya Pradesh and adjoining areas on the 1st and 2nd July. Nowgong reported 8″ of rain and Allahabad and Sutna 6″ each on the 1st; Jabalpur had 7″ on the 2nd. Strong monsoon conditions prevailed in most parts of northeast India on the 1st and 2nd.

The noteworthy district averages and particularly heavy rainfall amounts are given below:—

TABLE 6

State and Districts	District averages on June 29th	June 30th	July 1st	July 2nd	July 3rd	July 4th	July 5th	July 6th	July 7th	Particularly heavy falls
Madhya Pradesh										
Sagar	..	..	..	3·9	4·3	..	..	..	..	On 2nd July—Saugor Observatory 6·7″, Chandia Nallah 6·0″, on 3rd July—Mala Inspection Bungalow 7·9″, Rehli 6·3″, Damoh 6·3″, Garhakota 5·7″.
Jabalpur	..	..	..	2·1	3·3	..	..	..	..	On 2nd July—Borina 5·6″, Bahoribund 5·5″, on 3rd July—Murwara 7·4″, Amari 5·2″.
West Bengal										
Murshidabad	..	..	2·1	..	..	..	..	..	..	
West Dinajpur	..	..	2·1	..	..	..	..	..	..	
Jalpaiguri	..	..	..	2·5	..	..	..	..	..	On 25th June—Buxa 5·2″, on 1st July—Falakata 5·4″.
Darjeeling	..	..	..	2·6	3·3	..	..	..	2·2	On 30th June—Kurseong 5·0″, on 1st July—Kurseong 6·1″, on 6th July—Kurseong 6·3″.
Malda	..	..	..	2·3	..	..	..	..	..	On 29th June—Mathabhanga 5·0″.
Cooch Behar	3·0	..	..	5·0	..	..	..	..	..	On 2nd July—Mekhligunj 7·5″, Dinhata 5·6″, Mathabhanga 5·3″.
Bihar										
Patna	..	..	..	..	..	..	..	..	..	On 30th June—Ekangar Sarai 6·1″, on 6th July—Sarmera 6·8″, on 7th July—Asthanwan 5·3″, Bhaktiarpur 7·7″.
Muzaffarpur	..	2·1	..	..	..	..	..	2·6	2·2	On 30th June—Sitamarhi 7·0″, Bairagma 6·7″, on 6th July—Sheohar 6·2″, Minapur 6·6″, on 7th July—Mahua 7·8″.
Monghyr	..	..	2·1	..	..	..	..	2·7	..	On 30th June—Chakkai Banda 6·9″, on 1st July—Gidhaur 6·7″, on 6th July—Gidhaur 7·7″.
Bhagalpur	..	..	..	3·6	..	..	..	..	..	On 29th June—Sonola 5·6″, on 1st July—Colgong 5·1″, on 2nd July—Bhagalpur 6·3″, Amarpur 5·7″, on 3rd July—Amarpur 5·0″, on 7th July—Amarpur 5·8″.

TABLE 6—*contd.*

State and District	District averages on June 29th	June 30th	July 1st	July 2nd	July 3rd	July 4th	July 5th	July 6th	July 7th	Particularly heavy falls
Bihar—contd.										
Purnea	..	..	..	3·0	..	..	..	..	..	On 2nd July—Kishanganj 5·1″.
Santal Pargana	..	2·3	..	..	..	..	..	..	..	On 30th June—Kundahit 5·1″.
Hazaribagh	..	2·6	..	..	..	..	..	..	..	On 30th June—Barhi 6·3″.
Ranchi	..	..	..	..	..	..	..	..	..	On 30th June—Chainpur 5·8″.
Palamau	..	2·0	..	..	..	..	..	..	..	On 4th July—Balumath 6·9″.
Manbhum	..	..	..	..	..	..	..	..	..	On 6th July—Purulia 5·8″, Chandil 6·0″, Baghmundi 5·4″.
Uttar Pradesh										
Dehra Dun	..	..	..	2·7	..	..	..	..	..	On 1st July—Rajpur 7·0″,
Faizabad	..	4·8	..	..	..	..	..	..	..	On 30th June—Faizabad 5·5″, Tanda 5·0″, Ayodhya 7·1″.
Gonda	2·5	3·8	..	..	..	..	..	..	..	
Sultanpur	..	3·3	..	..	..	..	..	..	..	
Pratabgarh	..	3·5	..	..	..	..	..	..	..	
Fatehpur	..	..	..	..	3·8	..	..	..	..	
Allahabad	..	..	2·9	..	..	..	..	..	..	On 1st July—Allahabad 6·1″.
Jhansi	..	..	..	3·1	..	..	..	..	..	On 2nd July—Lalitpur 10·8″, Marhoni 11·0″.
Hamirpur	..	..	2·0	..	..	..	..	..	..	On 1st July—Kulpahar 6·7″, Belathal 5·0″.
Banda	..	..	..	..	3·1	..	..	..	..	On 3rd July—Banda Observatory, 6·3″, Baberu 7·3″.
Ghazipur	..	..	2·8	..	..	..	..	..	..	

5. Depression in the Bay of Bengal between 19th and 22nd July.—By the morning of 19th July, the seasonal trough had extended into the northwest Bay of Bengal, and pressures started falling along the Orissa-Circars coast. By the evening of the same day, conditions became markedly unsettled in the northwest and adjoining west central Bay of Bengal off the Orissa Circars coast. Unsettled conditions continued over the above region during the next 24 hours, and, by the 21st morning, a shallow depression formed with its centre near Lat. 18½°N., Long. 85½°E. The depression moved northwestwards and, by 1730 hrs. IST. of the same day, lay close to the coast between Gopalpur and Calingapatam. It crossed the coast near Calingapatam during the night, and weakened into a trough extending from Madhya Pradesh to the west central Bay of Bengal by the 22nd morning.

In association with the field of the above depression, the Arabian Sea branch of the monsoon strengthened and heavy rain was recorded in the south Konkan and Malabar south Kanara between the 21st and 23rd. Locally heavy falls were also reported from east Hyderabad on the 22nd.

6. Cyclonic storm in the Bay of Bengal between 24th and 29th July.—Conditions became again unsettled in the east central Bay of Bengal on the 23rd morning with the movement westward of a low pressure wave from lower Burma. By 0830 hrs. IST. on the 24th, the unsettled conditions concentrated into a depression centred near Lat. 17°N., Long. 89°E. The depression moved in a northwesterly direction, and intensifying at the same time, lay as a deep depression, with centre within half a degree of Lat. 18°N., Long 88°E. by 1730 hrs. IST. of the same day. S. S. Mac. Clay, which was then about 80 miles to the west of the depression, reported a northerly wind of 30 knots.

By the 25th morning, the deep depression had further intensified into a cyclonic storm, centred near Lat. 19°N., Long. 87°E. The storm continued to move rapidly in a westnorthwesterly direction, and lay with its centre very close to the coast near Puri by 1430 hrs. I.S.T. of the same day. It crossed the coast during the afternoon, and weakened into a deep depression, centred about 60 miles to the west of Puri at 1730 hrs. I.S.T. of the 25th. The following observations were recorded in the weather diary at Puri and Gopalpur on the 25th.

(a) **Puri.**—Sky mainly overcast with Fc/Fs clouds throughout day, with light intermittent rain from 0100-1730 hrs. Sky assumed threatening appearance towards afternoon. Force of wind gradually increased from noon and reached a speed of 50 to 60 m.p.h. by 1600 hrs. IST.

(b) **Gopalpur.**—The Sky was overcast with low and medium clouds. Slight continuous rain started at 0015 hrs. IST. and continued upto 0200 hrs. IST. The rain again started at 0525 IST and continued upto 0536 IST. Moderate rain started at 1315 hrs. and continued upto IST., then there was slight continuous rain from 1900 IST., to 2345 IST. Wind was NNW/NW till noon but afterwards became SW/SSW with average speed 16-20 m.p.h.

Moving in a northwesterly direction, the deep depression was centred about 50 miles southwest of Pendra on the 26th morning, and near Neemuch on the morning of the 27th. It then followed a northerly course and weakened into a depression, which was centred near Bikaner on the 28th morning. By the 29th morning it had merged with the seasonal trough over northwest India and became unimportant.

Under the influence of the above storm the monsoon was vigorous in south Madhya Pradesh and the Konkan between the 26th and 27th, and in Saurashtra and Kutch and Gujarat on the 27th. Locally heavy falls were also reported from coastal Andhradesa on the 24th.

A table showing noteworthy district averages of rainfall and amounts of particularly heavy rainfall is given below :—

TABLE 7

State and District	District averages on 23rd	24th	25th	26th	27th	Particularly heavy fall
Madhya Pradesh						
Durg	..	..	..	3·4	..	
Raipur	..	..	..	2·1	..	On 25th—Deobhang 5
Bastar	..	..	..	4·1	..	On 25th—Dantawara 5·2″, on 26th—Antagarh: 8·5″, Bhopalpatnam: 7·1″; Keskal 6·3″, Kanker 6·2

TABLE 7—*contd.*

State and District	District average on 23rd	24th	25th	26th	27th	Particularly heavy falls
Madhya Pradesh—contd.						
Chanda	..	..	..	4·6	..	On 26th—Warora 7·1″, Chimur 6·3″, Gadhchiroli 5·3″, Asola 7·3″, Ghorejheri 6·3″, Khairee 5·9″, Nalesar 7·9″, Germusi 6·0″, Sindewahi 6·0″.
Bhandara	..	..	..	3·3	..	
Balaghat	..	..	..	2·9	..	
Nagpur	..	..	..	2·4	..	
Wardha	..	..	..	3·3	..	On 26th—Hinganghat 5·7″.
Amravati	..	..	..	2·2	..	
Bombay and Saurashtra—Kutch						
Ahmedabad	..	..	..	..	2·5	On 27th—Viramgam 5·0″.
Kaira	..	..	..	..	2·4	On 27th—Nadiad 2·4″.
Pandi Mahals	..	..	..	..	4·3	On 27th—Jalod 14·5″, Sant 7·1″.
Surat	..	..	..	..	2·6	On 26th—Bulsar 5·1″, on 27th—Surat 6·1″, Bulsar 6·6″.
Baroda	..	..	..	..	..	Chota Udaipur 6.9″ on 27th
Banas-Kantha	..	..	..	..	3·0	Abu Road 5·8″ on 27th.
West Khandesh	..	..	..	..	..	Shirpur 5·1″ on 26th.
Nasik	..	..	..	..	..	Igatpuri 6·4″ on 27th.
Poona	..	..	..	..	..	Lonavala 5·7″ on 27th.
Satara-North	..	..	..	..	..	Mahabaleshwar 7·0″ on 26th, 6·2″ on 27th.
Danga	..	..	..	..	4·1	Waghai 6·3″ on 27th.
Kolhapur	..	2·1	..	..	..	On 23rd—Gangadharwadha 7·6″, on 24th—Gangadharwadha 9·2″, Radhanagari 5·1″, on 25th—Radaganthawadi 5·7″.
Thana	..	..	..	3·2	4·3	Mahim 7·4″ on 26th, Vadu 8·1″ on 27th, Sahapur 7·3″ on 27th, Bhiwandi 5·1″ on 26th.
Bombay	..	..	2·7	2·2	..	
Kolaba	..	..	2·6	3·1	3·8	On 25th—Roha 6·3″, on 26th—Karjat 5·2″, on 27th—Matheran 8·2″, Karjat 5·1″.
Ratnagiri	5·1	4·3	6·1	3·1	..	On 23rd—Ratnagiri 10·1″, Vengurla 8·5″, Malwan 7·5″, Kankavli 5·6″, Savantwadi 6·7″, Banda 5·8″, Amboli 10·7″, on 24th—Devrukh 10·1″, Kankavli 6·1″, Amboli 11·6″, on 25th—Ratnagiri 8·3″, Vengurla 5·1″, Rajapur 6·4″, Devrukh 5·8″, Chiplun 5·5″, Guhagar 7·5″, Khed 6·9″, Dapoli 7·5″, Mandangad 5·2″, Lanja 6·4″, Kankavli 5·3″, Savantwadi 6·4″, Banda 6·2″, Amboli 5·6″, Kudal 7·1″, on 26th—Mandangad 5·3″, on 27th—Mandangad 5·1″.
North Kanara	4·7	3·6	3·0	2·1	..	On 23rd—Ankola 5·1″, Kumta 8·9″, Bhatkal 5·7″, Sirsi 5·4″, Siddapur 6·6″, on 24th—Ankola 5·2″, Siddapur 5·2″, on 25th—Sirsi 5·1″.
Madras State						
Visakhapatnam	..	2·8	..	..	..	On 24th—Narasapatnam 5·5″, Waltair 6·4″, Anakapalli 5·1″.
E. Godavari	..	2·2	..	..	..	On 24th—Bhadrachalam 6·3″.
W. Godavari	..	2·2	..	..	..	On 25th—Chintalapudi 5·5″, Byennaweir 5·3″.

7. Depression in the Bay of Bengal—30th July to 1st August.—A low pressure wave from the east started affecting upper Burma by the 26th. It gradually shifted westwards and moved by the 29th morning into the north Bay of Bengal, where a cyclonic circulation appeared upto 7,000 ft. a.s.l. Pressures over the eastern parts of the country and along the Arakan-Chittagong coast commenced failing, and by the evening this tendency became more concentrated along the West Bengal-Orissa coast, where an area of comparatively large negative pressure departures appeared. These showed that the conditions had by then become markedly unsettled over the northwest Bay of Bengal. By the next morning, a depression formed with centre at 0830 hrs. IST. about 50 miles southeast of Chandbali. Moving northwestwards without intensification, the depression lay at 1730 hrs. I.S.T. on that day with centre close to the Orissa coast near Chandbali. It crossed coast in course of the night, and continuing to move northwestwards was centred about 60 miles west of Balasore at 0830 hrs. I.S.T. on the 31st. Moving rapidly thereafter, it was centred near Umaria at 1730 hrs. I.S.T. on that day. By the next morning, however, it weakened and merged with the seasonal trough.

In association with the formation and movement of this depression, the monsoon was active in northeast India on the 29th, and was active to vigorous in east Madhya Pradesh on 31st July and 1st August and in north Hyderabad and Vindhya Pradesh on the 31st July. Kanker in northeast Madhya Pradesh recorded 11″ of rain on the 31st, this being the heaviest fall for a day at that place during the past 20 years.

The following table gives the noteworthy district averages of rainfall and the particularly heavy rainfall amounts which occurred under the influence of the above depression.

TABLE 8

State and District	District average on July-August 29th	30th	31st	1st	Particularly heavy falls
Madhya Pradesh					
Durg	..	..	2·0	..	
Raipur	..	..	2·3	..	On 31st July—Maramsilli 7·0″, Mahasamund 6·0″, Gattasilli 5·2″.
Raigarh	..	..	2·1	..	On 31st July—Sarangarh 6·3″.
Bastar	..	..	4·3	..	On 31st July—Kanker 11·4″, Antagarh 9·1″, Dantiwara 5·5″.
Sagar	..	..	2·2	..	On 31st July—Jabera 5·9″.
Chanda	..	..	2·6	5·3	On 30th July—Dhanora 6·3″, Nalesar 6·0″, on 31st July—Dhanora 11·3″, Armori 7·1″, Brahmapuri 6·9″, on 1st August—Sindhewahi 9·5″, Garmusi 9·5″, Ghorajheri 8·4″, Asola 8·0″, Nalesar 7·7″, Khairee 7·5″, Mul 7·4″, Gadhchiroli 8·4″.
Wardha	..	..	..	3·2	
West Bengal					
24-Parganas	..	..	..	..	On 29th July—Saugor Island 5·8″.
Howrah	3·7	..	..	..	On 29th July—Amta 6·3″.

8. Shallow depression in the Bay of Bengal,—4th-5th August.—The seasonal trough was seen to have extended into the northwest Bay of Bengal on the 2nd morning, and a cyclonic circulation was also developing over the northwest Bay and the adjoining land areas, upto 7,000 ft. a. s. l. By the next morning, an area of concentrated negative pressure departures appeared over the northwest Bay and the associated upper air cyclonic circulation became more pronounced, showing that conditions had become markedly unsettled in the northwest Bay. In course of the next 24 hours, the unsettled conditions concentrated into a shallow depression, centred at 0830 hrs. I.S.T. on the 4th about 50 miles east of Chandbali. The shallow depression moved westwards without intensification and lay close to the coast near Chandbali on the afternoon of that day. The depression crossed the Orissa coast during night, and weakened into a low pressure area which lay over Orissa and northwest angle of the Bay on the 5th morning.

Under the influence of this depression, a few heavy falls of rain were reported from Orissa on the 4th.

9. Shallow depression in the Bay of Bengal—16th-19th August.—The seasonal trough was extending into the northwest Bay of Bengal on the 15th morning. Associated with this, there was an upper air cyclonic circulation over the northwest Bay upto 7,000 ft. a. s. l. As seen from the comparatively large pressure fall along the Arakan coast, a low pressure wave was moving into the northeast Bay on this day. On the 16th morning, an area of concentrated negative pressure departures appeared over the north Bay of Bengal and the upper air cyclonic circulation also became well-marked, suggesting that a shallow depression had formed in the north Bay of Bengal with centre at 0830 hrs. I.S.T. near Lat. 20½°N., Long. 89½°E. Moving northwest it was centred near Saugor Island at 1730 hrs. I.S.T of the same day. The depression crossed the coast during the night and lay over Gangetic West Bengal with its centre about 30 miles west of Bankura at 0830 hrs. I.S.T. of the 17th. Thereafter, it weakened and lay as a low pressure area over northeast Madhya Pradesh and adjoining areas on the 18th morning. Shifting to east Uttar Pradesh, it became unimportant by the 20th morning.

Under the influence of this depression, the monsoon was particularly active over the region extending from Gangetic West Bengal and coastal Andhradesa to the Punjab (I) and Madhya Bharat on the 16th and 17th.

10. Shallow depression in the Bay of Bengal—30th August-1st September.—Under the influence of a low pressure wave from the east, the eastern end of the axis of the seasonal trough, which had been lying close to the Himalayan foot hills for the past few days, moved southwards into the north and adjoining central Bay of Bengal by the 29th morning. A cyclonic circulation in the upper air was also developing at the time over the area upto 10,000 ft. a.s.l. These, together with pressure fall around the head Bay, suggested that conditions had become unsettled over the north Bay of Bengal and neighbourhood. A well-marked low pressure area formed over the north Bay of Bengal by the 30th morning with a pronounced upper air circulation. By the afternoon of the same day, the low pressure area concentrated into a shallow depression, centred near Lat. 20°N. and Long. 89°E. at 1730 hrs. I.S.T. The depression moved northwestwards and was centred between Balasore and Contai at 0830 hrs. I.S.T. of the 31st. Thereafter, it crossed the coast, weakened and lay as a low pressure area over north Orissa and adjoining Chota Nagpur on the 31st afternoon. The low pressure area merged into the seasonal trough by the next morning.

In association with the disturbance, Orissa had widespread rain on the 30th and 31st August, Balasore reporting 3″ of rain on the 31st.

11. Land depression from 9th September to 13th September.—Falling pressure and negative pressure departures over Burma on the morning of the 7th September indicated approach of a low pressure wave from the east. By the next morning Mandalay winds became northerly at 2,000′ a.s.l. and eastnortheasterly at 3,000′ a.s.l. and a well-marked low pressure area appeared on the surface chart over upper Burma. By the same afternoon, the winds over Arakan coast also became northerly to northwesterly. On the 9th morning, winds at Chittagong were northwesterly 30 kts. upto 3,000′ a.s.l., and the zone of negative pressure departures had become more concentrated. These together with the fact that very heavy rainfall amounting to 16″ and 8″ was recorded at Akyab and Cox's Bazar respectively during the 15 hrs. ending at 0830 hrs. IST. of the 9th, showed that a depression had formed over central Burma and adjoining East Pakistan with its centre, at 0830 hrs. I.S.T. of the 9th about 90 miles eastnortheast of Cox's Bazar. The depression moved westnorthwestwards and lay near Chittagong on the same afternoon. Continuing to move in the same direction and intensifying at the same time, the depression reached Gangetic West Bengal by the 10th morning, when it lay as a deep depression with its centre near Burdwan. By the next morning, it weakened into a depression and was then centred about 100 miles east of Sutna. On the 12th morning, the depression was over Vindhya Pradesh, with its centre about 50 miles east of Nowgong. Thereafter, it took a northnorthwesterly course and was centred successively between Agra and Mainpuri on the 13th morning, and between Mainpuri and Aligarh on the same afternoon. The depression finally broke up over the hills of west Uttar Pradesh by the 14th morning.

Under the influence of the depression, there was fairly widespread rain over the belt extending from West Bengal and Orissa to west Uttar Pradesh between the 10th and 13th, rain being locally heavy to very heavy along and near the track of the depression. Locally heavy falls continued in northwest Uttar Pradesh on the 14th also. The noteworthy district averages of raintall and particularly heavy falls of rain which occurred in association with this depression are given in the following table :—

TABLE 9

State and District	District averages on 9th	10th	11th	12th	13th	14th	Particularly heavy falls
West Bengal							
Jalpaiguri	..	..	..	..	2·3	..	On 10th—Bux 9·0″, on 13th—Alipur Duars 5·6″.
Darjeeling	..	..	3·7	..	..	..	On 11th—Darjeeling 5·6″, Mongpoo 5·7″.
Bankura	..	2·2	..	..	..	..	On 9th—Indas 5·1″, Sonamukhi 6·8″, Simplapol 5·1″.
Burdwan	..	3·6	..	..	..	..	On 10th—Burdwan 6·5″, Mankar 5·9″.
Hoogly	2·3	..	..	..	..	..	On 10th—Chanditola 5·4″
Howrah	..	3·5	..	..	..	..	
Bihar							
Hazaribagh	..	..	2·0	..	..	..	On 10th—Petarbar 5·8″, on 11th—Barakartha 5·5″, Chagra 5·3″.
Ranchi	..	..	2·0	..	..	..	
Manbhum	..	2·3	2·9	..	..	..	On 11th—Raghunathpur 5·5″, Nirsa 7·3″, Manbazar 5·1″.

TABLE 9—*contd.*

State and District	District averages on 9th	10th	11th	12th	13th	14th	Particularly heavy falls
Uttar Pradesh							
Meerut						2·3	
Bulandshahr						2·5	On 13th—Dayanathpur 5·0″, on 14th—Bulandshahr 5·0″, Anupshahr 6·7″.
Agra					2·2		
Etah						2·0	
Bareilly	2·5					2·0	
Bijnor						6·5	On 14th—Dhampur 11·1″.
Budaun						2·1	
Moradabad						4·1	On 14th—Amroha 7·1″.
Shahjahanpur	2·7						
Farrukhabad	2·4						
Etawah					2·1		
Jhansi				2·2			
Jalaun				2·3			
Hamirpur				2·5			
Banda				3·1			On 12th—Girewan 5·6″, Karwi 5·8″.
Banaras	2·9						
Jaunpur	2·1						On 9th—Kerakut 6·3″.
Ghazipur				2·2			On 12th—Saidpur Bhitari 5·6″.
Azamgarh							On 9th—Devgaon (Lalganj) 5·3″.
Nainital						4·4	On 14th—Kaladhungi 5·5″, Nainital 12·0″, Nagla 6·0″, Ramnagar 6·9″.
Almora						2·6	On 14th—Champawal 7·1″.
Garhwal						2·8	On 13th—Bironkhal 8·4″, on 14th—Lansdowne 5·6″.
Madhya Pradesh							
Betul	2·2						On 9th—Harrai 6·5″.

12. Bay depression from 11th to 16th October.—A trough of low pressure appeared over the central Bay and the adjoining north Bay of Bengal on the 7th morning. It gradually concentrated and by the 9th morning, a weak cyclonic circulation in the upper air developed over the area. By the 10th morning, stations along the Orissa coast started raining, and the cyclonic circulation around the north and adjoining Bay had become more marked. Pressure departure chart for the morning showed a low, with pressure defect of more than 5 mbs. over the northwest and the adjoining west central Bay. During the next twenty-four hours the unsettled conditions concentrated into a depression, which was centred at 0830 hrs. IST. of the 11th near Lat. 19°N., Long. 87°E. Moving northnorthwestwards, the depression lay close to the coast between Puri and Chandbali on the same afternoon. It crossed the coast during the night and, after weakening, lay as a 'low' over southeast Madhya Pradesh and neighbourhood on the 12th morning. Later, the 'low' moved in a westerly direction across south Madhya Pradesh, north Deccan (Desh) and south Gujarat and finally merged by the 15th, into the trough over the northeast Arabian Sea off the north Konkan-Kathiawar coast.

In association with the formation of the depression and its movement later at different stages of its development, fairly widespread rain occurred along the Orissa coast on the 10th, in Orissa, West Bengal and Assam on the 11th and in east Madhya Pradesh and northeast India outside Bihar and sub-Himalayan West Bengal on the 12th and 13th. Local or fairly widespread rain also occurred in west Madhya Pradesh between the 13th and 15th, in north Deccan (Desh) between the 14th and 16th and in the north Konkan on the 16th and 17th. A few heavy falls were also reported from Orissa on the 11th, from west Madhya Pradesh on the 13th, from north Deccan (Desh) on the 15th, and from the north Konkan on the 16th and 17th. According to newspaper reports, the rainfall over north Deccan (Desh) and the north Konkan was very heavy at places causing severe floods, and loss of human life, cattle and property in parts of these areas.

The noteworthy district averages of rainfall and the particularly heavy falls caused in association with this disturbance are given in the following table.

TABLE 10

State and District	District averages on 11th	12th	13th	14th	15th	Particularly heavy falls
Bombay						
East Khandesh					2·5	
Nasik					2·5	On 15th—Yeola 10·9″, Nandgaon 9·6″.
Ahmednagar					2·1	On 15th—Kopargaon 13·0″
Assam						
Goalpara						On 15th—Kachugaon 6·1″
Lushai Hills	2·3					On 11th—Sialsuk 5·1″.
Madhya Pradesh						
Durg						On 12th—Khamaria 6·7″
Bilaspur						On 12th—Jaujgir 8·6″.
Mandla			2·6			
Balaghat						On 13th—Baihar 5·6″.
Betul				2·0		

13. Severe cyclonic storm in the Arabian Sea—12th to 19th November.—Under the influence of a low pressure wave from the east, a trough developed in the central region of the south Arabian Sea on the 10th morning. By the next morning, the trough became well-marked and by the 12th morning intensified into a depression centred at 0830 hrs. I.S.T. near Lat. 8½°N., Long. 63½°E. In a special message at 0930 hrs. I.S.T., S. S. Singkep (Position Lat. 9·7°N., Long. 62°E.) reported 360°/28 Kts. wind and moderate intermittent rain. The report also added "Weather deteriorated rapidly last 12 hours. Continuous squalls with wind reaching B.F.9 and barometer far below normal". The pressure deficiency at the centre of the depression was on this day about 7 mbs. The depression moved northwards initially and was centred near Lat. 9½°N., Long. 63½°E. at 1730 hrs. I.S.T. of the 12th and at Lat. 11°N., Long. 64°E. at 0830 hrs. I.S.T. of the 13th. At 1030 hrs. I.S.T. of 13th, S. S. City of Poona, (Lat. 9·3°N., Long. 66°E.), reported wind speed of 33 Knots, at 1330 hrs. I.S.T. 30 knots and at 1730 hrs. I.S.T. 28 knots. These strong winds indicated that the depression had intensified into a cyclonic storm with centre at 1730 hrs. I.S.T. on the 13th near Lat. 11½°N., Long. 64°E. The pressure deficiency at the centre of the storm at this time was about ten millibars. The storm then took a northnortheasterly course, and was centred near Lat. 13°N., Long. 65°E. at 0830 hrs. I.S.T. of the 14th and near Lat. 15°N., Long. 65½°E. at 1730 hrs. I.S.T. of the same day. It is interesting to note that S. S. Masimpur at 1130 hrs. I.S.T. and S. S. British Marquis at 1130 and 1730 hrs. I.S.T, about 250 to 300 miles to the north of the centre, reported NE winds of about 30 knots. As seen from the available ships reports winds at the distance of 250-300 miles from the centre in other directions were not so strong. British Marquis at 1130 hrs. I.S.T. and at 1730 hrs. I.S.T. reported waves both from SSW and NNE-ENE as against the wind from NE. Apparently the former was swell from SSW.

The storm was centred near Lat. 17½°N., Long. 66°E. at 0830 hrs. I.S.T. of the 15th and was apparently severe, as seen from the observation of S. S. Dwight L. Mody which at 0930 hrs. I.S.T. reported wind of 9B.F. from north at a position about 60 miles westnorthwest of the centre of the storm. During the next 24 hours, the severe cyclonic storm had only a little northward movement. At 1730 hrs. I.S.T. of the 15th, the barometric pressure at the centre of the severe storm was distinctly lower than 990 mbs. with a negative departure of more than 22 millibars as seen from the 1730 hrs. I.S.T. report of S. S. Chusan which was sailing close to the storm. Some interesting ships reports of this day, including these from S. S. Chusan, are given in Table 11. A graph showing the barometric pressure and the winds recorded by S. S. Chusan on this day is also added (*vide* Fig. 1).

The severe storm was centred near Lat. 18°N., Long. 66°E. at 0830 hrs. I.S.T. on the 16th and was near Lat. 19°N., Long. 66°E. at 1730 hrs. I.S.T. of the same day, when it was weakening. By the 17th morning, the storm had weakened into a depression with centre at 0830 hrs. I.S.T. near Lat. 20½°N., Long. 67½°E., and at 0830 hrs. I.S.T. of the 18th near Lat. 21°N., Long. 68°E. By the evening of 18th, the depression weakened into a trough of low pressure which extended into Saurashtra and became unimportant during the next 12 hours.

In association with this storm, locally very heavy rain was reported from northwest Saurashtra on the 18th. An exceptionally heavy fall of 14″ in 24 hours—the heaviest fall on record during the last 50 years—was reported by Dwarka on the morning of the 18th, out of which nearly 12″ of rain fell within 9 hours. It may be also mentioned that the normal annual rainfall at Dwarka is 13·93″ and that for November is only 0·08″. According to press reports, 14 persons were drowned in floods in Dwarka town and breaches occurred in the railway track between Bhatia and Varvala isolating Okha town.

TABLE 11

Date	Time G. M. T.	Name of ship	Position		Wind	Pressure Mbs.	Weather
			Lat.	Long.			
15th	0001	Dwight L. Mody	17·5°N	65·1°E	360° 40K	1001·3	
	0400	Do.	17·7°N	64·9°E	360° 44K	1002·0	
	0800	Do.	17·6°N	64·6°E	320° 40K	1002·0	Bar. falling; sky overcast rainsqualls wind WNW B.F. 7-8 increasing in squalls to B.F. 9-10. Sea north rough.
	1200	Do.	17·9°N	64·7°E	340° 40K	1000·7	
	0600	S. S. Masimpur	17·5°N	64·0°E	330° 34K	1004·4	Squalls during the last hour.
	0800	City of Rochester	20·0°N	66·7°E	050° 37K	..	Rain.
	1200	Do.	19·7°N	66·1°E	050° 37K	..	Bar. falling slowly; overcast with continuous rain.
	0700	S. S. Chusan	16·8°N	63·6°E	340° 24K	1003·0	Overcast; frequent heavy rainsqualls moderate sea and confused swell.
	0900	Do.	16·8°N	64·5°E	340° 37K	997·9	
	1100	Do.	17·1°N	65·2°E	290° 37K	990·5	Overcast with frequent heavy rain, pitching at times to heavy NE swell and rough NW sea.
	1200	Do.	17·2°N	65·5°E	320· 37K	990·3	
	1300	Do.	17·3°N	65·9°E	230° 37K	988·8	
	1500	Do.	17·4°N	66·7°E	230° 30K	995·6	Fine and cloudy heavy continuous rainsqualls earlier; high variable swell and very rough sea.
	1800	Do.	17·7°N	67·7°E	180° 37K	1000·0	
	1900	Do.	17·9°N	68·2°E	140° 30K	1001·3	
	2230	Do.	18·4°N	69·7°E	160° 24K	1003·0	Cloudy with occasional passing rainsqualls in first half; lurching to moderate south-westerly swell and rough SSE sea.

14. Depression in the Bay of Bengal between 23rd and 26th November.—Under the influence of a low pressure wave which moved from the east across south Tenasserim, the seasonal trough in the south Bay of Bengal became well-marked by the 21st. It concentrated further, and conditions became markedly unsettled in the southeast Bay of Bengal on the morning of the 23rd. The unsettled conditions shifted westwards and by the 24th morning a depression formed with its centre near Lat. 12°N., Long. 85°E. The depression moved northnorthwest, deepened and, on the morning of the 25th, was centred about 50 miles south of Visakhapatnam. The depression then weakened rapidly, and by the evening of that day lay as a trough off the Orissa coast, which later moved away northeastwards as a low pressure wave.

In association with this depression, widespread rain occurred in the northern districts of coastal Andhradesa and in south Orissa on the 25th and in northeast India, outside sub-Himalayan West Bengal and Bihar, on the 26th. Calingapatam reported 3″ of rain on the 25th.

15. Severe cyclonic storm in the Bay of Bengal—5th-14th December.—A low pressure wave from the east moved into the south Andaman Sea by the 4th morning. By the same evening, the seasonal trough over the Andaman Sea and the adjoining southeast Bay of Bengal became well-marked. A ship S. S. Rajula (position Lat. 6·5°N., Long. 94·2°E.) reported squalls at 1730 hrs. I.S.T. and 2330 hrs. I.S.T. on 4th and also at 0530 hrs. I.S.T. of 5th. This showed that conditions were markedly unsettled over the above-mentioned areas. By 5th evening, the unsettled conditions concentrated into a depression centred at Lat. 7½°N., Long. 90°E. The depression took a northwesterly course and became deep by the 6th morning when it was centred near Lat. 9°N., Long. 89°E. At this stage, Port Blair reported winds ESE 30 Kts. and SS Nurani, about 200 miles NNW of the depression, reported winds ENE 33-35Kts. in the morning and ENE 42 Kts. at 1430 hrs. I.S.T. These showed that the deep depression had further intensified into a cyclonic storm during the afternoon of 6th, being centred at 1730 hrs. I.S.T. near Lat 10°N., Long. 88°E. The storm apparently deepened without appreciable movement during the following 24 hours. Thereafter it moved in a northnorthwesterly direction and was centred near Lat. 11½°N. Long. 87½°E. on the 8th morning. At 1730 hrs. I.S.T. of the same day the cyclonic storm was severe and was centred near Lat. 13°N. Long. 87½°E., as shown by the northerly winds of 10 BF. reported by Motor Ship Kungaland, position Lat. 13·7°N., Long. 85·4°E. The severe cyclone was centred at 0830 hrs. I.S.T. on the 9th near Lat. 14°N., Long. 87½°E. and the pressure deficiency at the centre was then about 15 mbs. The following observations of the ship Kungaland are relevant in this connection:—

TABLE 12

Date	Ship's Time I.S.T.	Position Lat.	Position Long.	Wind direction	Force B.F.	M. S. L. Pressure	Sea	Weather
8th December	1200	13°29′N	84°13′E	NNE	4	1003·7	rough	...
	2000	..	..	N	10	1000·3	rough	rain.
	Midnight	..	..	N	9	1000·3	rough	rain.
9th December	0400	..	..	N	9	995·0	rough	..
	0800	..	..	WNW	10	995·0	rough	..
	1200	14°02′N	87°44′E	NW-W	10	995·0	rough.	..
	1600	..	..	W	10	990·4	rough	rain.
	2000	..	..	WNW	8	995·6	rough	..
	Midnight	..	..	WSW	8	999·6	rough	..
10th December	1200	14°13′N	92°12′E	S	7	1005·1	rough	..
	1600	..	..	S	6	1005·1	rough	..
	2000	..	..	S	5	1006·4	rough	..
	Midnight	..	..	S	4	1006·4	..	..

The storm recurved northnortheastwards and was centred at 0830 hrs. I.S.T. of the 10th near Lat. 17°N., Long. 88½°E. S. S. Jalaprakash (Lat. 17·7°N., Long. 87·1°E.) reported NW'ly wind of 50 Kts. at 1730 hrs. I.S.T. on the same day. This showed that the storm which was then centred near Lat. 18°N., Long. 88½°E., was still severe and had a core of violent winds. The storm was centred on the 11th morning near Lat. 18½°N., Long. 89°E., and was showing signs of weakening. On the 12th morning, it lay as a deep depression centred a little to the north of its position on the previous day. By the 13th morning, it further weakened into a depression centred at 0830 hrs. I.S.T. near Lat. 20°N., Long. 90°E. and by the same evening into a trough of low pressure along the Chittagong-Arakan Coasts. The trough subsequently moved into Burma by the 15th as a low pressure wave and became unimportant by the 17th.

Under the influence of this storm, Port Blair had 3″ of rain on the 7th and 4″ each on the 8th and 9th. Despite considerable distance from the cyclone, heavy swells affected the entire east coast of India restricting the free movement of ships at many ports. Inundation of certain low lying coastal areas and some damage to light vessels were also reported.

The following are the notes recorded by the Captain of S. S. Nurani relating to the weather between the 6th and 8th:—

Copy of remarks by S. S. Nurani.

Date	Position	
Noon 6-12-51	12°·01′ N. 88°·04′ E.	Recorded that the Vessel became unmanageable in heavy weather whilst proceeding on passage on Colombo to Moulmein in ballast trim

and during the 24 hours—noon 5th to noon 6th December; had averaged 3¾ knots. At noon 6th December, with full gale conditions with wind NE/E force 8-9, with corrected barometer 1006:1 mb. falling steadily with steady to veering wind, the undersigned Master decided that the 'depression' of the W/T Met. reports had developed into a severe cyclonic storm to the southeast direction and that the vessel was in its estimated path or slightly to the right of it in the dangerous advance quadrant. In the safety of the vessel she was deviated from her course to Moulmein and hauled westwards to run round the west side of the cyclone and come round into the rear quadrant barometric pressure being 6 mb. below normal for the area. Engine speed being adjusted to requirements of keeping the vessel under control.

(*Sd.*) *P. M. Bapty, Mate.* (*Sd.*) *J. Thompson, Master.*

Date	Position	
Noon 7-12-51	11°·21′ N. 86°·00′ E.,	Course varied south westerly as vessel worked around to the west side of cyclonic storm reported by W/T Met. report of 1200 GMT. December 7th as

being within half degree Lat. 10½°N., Long. 88½°E. and likely move northwest and intensify further.

Weather at ship mainly overcast with rain squalls and fresh to strong gale throughout. Lurching and labouring heavily in very rough sea and very heavy swell. Wind north force 8-9 and backing with very high swell from east. Corrected barometer 1007·7 mb. steadied with tendency to rise slightly. Estimated bearing of centre at 0800 hrs. (0200 GMT) being 112° from vessel in Lat. 11°:20′N., Long. 86°:30′E. approx. distant about 130 miles. Vessel hauled more to southward in the afternoon watch to about SSW, and to S-W at 2100 hrs. Keeping barometer steady and equidistant from centre estimated. At 2200 hrs. with improving conditions vessel was hauled to ESE direction to come into rear of storm and resume course.

(*Sd.*) *P. M. Bapty, Mate.* (*Sd.*) *J. Thompson, Master.*

Date	position	
Noon 8-12-51	10°·15′ N. 85°·18′ E.	Recorded that vessel now heading east into rear quadrant of storm. Weather:—Wind WNW, Force 7. Bar corrected 1006·6 mb. Tendency fall slowly. Overcast with rain squalls; lurching and labouring and rolling, heavily to WNW wind across NE swell by 2100 hrs. 8th and resumed her course to Table Island across the rear of the cyclone, but even at slow speed was overtaking it and as the barometer had fallen 3·3 mb. in 4 hours by 0400 hrs. on the 9th instant with deteriorating conditions, course had to be bent to proceed *via* the TEN DEGREE CHANNEL south of the Andaman involving about 100 miles extra streaming, but with prospect of better weather in the event of the cyclone recurving over Arakan coast as expected and disturbing conditions in the Gulf of Martaban.

(*Sd.*) *P. M. Bapty, Mate.* (*Sd.*) *J. Thompson, Master.*

II. ACCOUNT OF WESTERN DISTURBANCES DURING 1951

Many of the western disturbances which moved across north India during 1951 were feeble and produced little rainfall in the areas affected by them. However, some of the disturbances of the hot weather period March to May and a few in February and November were more active than the rest. In January, the second disturbance was fairly active and caused some heavy snowfalls in the hills of the Punjab (I) between the 8th and 10th, resulting in dislocation of motor traffic along the roads leading to Simla. In March, the earlier disturbances did not cause appreciable precipitation in northwest India, but the deficiency of rainfall during the first three weeks was practically made up by the last disturbance of the month. In May, the western disturbances were less active than usual, but the first and last of them caused a number of dust-storms in the Punjab (I) and the west Uttar Pradesh. Most of the disturbances during the period October to December were feeble.

A list of the disturbances classified according to the nature of precipitation caused by them is given in the table below. A description in detail of some of the more important western disturbances is also added.

TABLE 13

Nature of precipitation	Number of western disturbances											
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Widespread	5	3	2	2	3	..	..	..	..	..	1	..
Local	1	2	1	1	4	..	..	..	..	..	..	..
Little or no rain	5	3	3	1	1	..	..	..	..	2	2	7
TOTAL	11	8	6	4	8	..	..	..	..	2	3	7

Western Disturbance of 29th January to 1st February, 1951.—This western disturbance was fairly active. It began affecting Baluchistan on the 29th January. Moving in a northeasterly direction, it lay over the southern districts of the Punjabs and the neighbourhood on the 31st, and passed away across the hills of the Punjab (I) and west Uttar Pradesh by the 1st February after inducing a secondary disturbance over the Punjab (P) on the same day. The latter persisted for some time as a well-marked upper air circulation over the Punjab(I) and then passed away across the Western Himalayas by the 4th. A well-marked low which was apparently induced in its turn by the above secondary disturbance, lay over west Madhya Pradesh and Madhya Bharat on the 5th and moved rapidly eastnortheastwards to north Bihar on the 6th and subsequently filled up there.

The primary disturbance caused local thundershowers in the Punjab (P) and the hills of west Uttar Pradesh on the 31st January. Widespread or local rain or snow also occurred in the plains of the Punjab(I) and the hills of the Punjab(I) and west Uttar Pradesh on the 2nd and 3rd. The low over west Madhya Pradesh was responsible for widespread or local thundershowers in east Uttar Pradesh and in and near Vindhya Pradesh and in west Madhya Pradesh on the 5th and 6th. The thundershowers in west Madhya Pradesh were accompanied by hailstorm at many places. According to newspaper reports, the rabi crops in the affected areas suffered considerable damage.

In the wake of the secondary disturbance, a cold wave swept across northwest India and the central parts of the country between the 2nd and 4th. In Rajasthan, night temperatures fell below the freezing point at many places on the 2nd. Three persons were frozen to death in Saurashtra on the 3rd.

Western Disturbance of 21st to 27th March 1951.—This disturbance appeared over Baluchistan on the 21st March. Moving in an eastnortheasterly direction it lay over Sind and the adjoining parts of west Rajasthan on the next day. It then moved to the Punjab (P) and neighbourhood on the 24th, and persisted there for the next two days, when it was very active. It then weakened rapidly and passed away across the western Himalayas on the 27th. During this period, there was also a persistent incursion of moist Bay air into northeast India and the central parts of the country, in association with a well-marked anti-cyclone over the Bay of Bengal. The western disturbance was responsible for widespread or local thundershowers in most parts of northern India between the 25th and 27th. Locally heavy falls of rain were reported from the hills of the Punjab (I) and west Uttar Pradesh on the 26th. According to newspaper reports, Jullunder had a heavy downpour continuously for nearly 50 hours ending on the 27th morning. One person, being struck by lightning died in Jullunder City. The heavy rains in the Punjab(I), Rajasthan and Madhya Pradesh were accompanied by thunder and hail storm and in these areas standing crops were reported to have been damaged to some extent.

Western Disturbance of 21st to 24th November 1951.—This disturbance appeared as a diffuse circulation over north Baluchistan and neighbourhood on the 21st and moved northeastwards across the Punjabs and the adjoining parts of north Rajasthan on the 23rd. It finally moved away across the hills of the Punjab (I) by the 24th. Although the primary disturbance was feeble and did not cause any appreciable weather over the affected areas, it induced a secondary over the north Arabian Sea off the Saurashtra coast by the 22nd which was more productive of weather. Moving in an eastnortheasterly direction at first, it lay over north Gujarat and the adjoining parts of Rajasthan on the 23rd. Later, it moved northeastwards and passed away across the hills of the Punjab(I) on the 26th morning. The secondary caused widespread thundershowers, with locally heavy falls, in north Gujarat and west Rajasthan on the 25th and in the Punjab (I) and west Uttar Pradesh on the 25th and 26th. Some of the notable rainfall amounts on 26th are Faizabad 5·6″, Khora 5·5″, Ambala 5·3″ and Dharampur 5·1″. There were also reports of snowfall in the Himachal Pradesh and in Kashmir on the 26th. Simla had the first snowfall of the season on the 25th.

III.—LOCAL STORMS

Of the local storms reported in newspapers the following are noteworthy :—

Place	Date	Time	Classification of storm	Loss of human life	Remarks
Boria (Near Diamond Harbour)	20th March	Midday	Violent storm followed by waterspout.	..	The storm which was followed by a waterspout at the mouth of the Hoogly, destroyed a school building injuring 50 boys. The waterspout which was reported to have reached the level of the thunderclouds, persisted for 15 minutes. Some 30 houses in the vicinity were destroyed by the storm.
Hissar	24th March	..	Severe thunderstorm	10	Ten persons were killed and 9 injured in a refugee camp hit by the storm. Extensive damage to crops was reported. Many cattle were killed and roofs of houses blown off.
Jaipur	24th March	Night	Hailstorm	..	Considerable damage was caused to crops. The city was temporarily plunged into darkness as hailstones damaged high tension wires in some sections of the town.
Allahabad	6th April	Evening	Severe hailstorm	..	Huge trees were uprooted, interrupting traffic in some places. Electricity was cut off in some parts of the city and business was brought to a stand-still.
Gauhati	22nd April	Afternoon	Hailstorm	..	Some of the hailstones were reported to have weighed more than a pound. Several roofs were damaged and glass-panes broken. Many refugees were rendered homeless.
Gauhati	28th April	Night	Hailstorm	..	A number of huts collapsed. Roofs of several thatched houses were blown off. This storm caused power supply to be cut off resulting in serious dislocation in the working of the All India Radio Station and newspapers' offices in the city.
Manibandh village (Puri District, Orissa).	28th April	..	Thunderstorm	8	A school building collapsed killing eight children and injuring six.
Delhi	30th April	Evening	Dust and thunderstorm	..	Maximum wind speed recorded at Safdarjung was 56 m.p.h. Temperature fell by 18°F. from 91·5°F. before the storm to 73·5°F after it.
Calcutta	1st May	Afternoon	Nor'wester	..	Nearly 2 inches of rain was recorded at Alipore in association with the storm and temperature fell by 23°F. during the storm. Hailstones were also reported to have fallen at one stage during the storm. Low lying areas in the city were flooded and tram services were dislocated in some parts of the city.
Jaipur	1st May	..	Duststorm followed by thunderstorm.	..	The storm completely darkened the city for about half an hour and was followed by a heavy downpour.
Begumpet	17th May	Afternoon	Hailstorm	2	Strong winds accompanying the storm caused the massive gate of a hanger to fall down, killing two persons and injuring one. Maximum wind speed reached in squall was 73 miles per hour.
Salem	17th May	Evening	Hailstorm	..	Hailstones of the size of eggs, together with high winds caused considerable damage to houses and mango crops.
Bellary	17th May	Evening	Heavy gale and rain	..	Several bamboo sheds collapsed. Trees and telegraph poles were uprooted and power supply was cut off in the town for 4 hours. Total damage was estimated at Rs. 10,000.
Katlamari (Behrnmpore District, West Bengal).	20th May	..	Thunderstorm	1	A school building collapsed killing one and injuring four persons.
Calcutta	21st May	Evening	Nor'wester	1	Wind speed reached 64 miles per hour during squall and temperature dropped by 14°F. Uprooted trees interrupted tram traffic in some places. Electric installations were damaged in some parts of the city. Low lying areas were flooded. One person was killed and two injured.

Place	Date	Time	Classification of storm	Loss of human life	Remarks
Mussooree	23rd May .	Evening .	Severe thunderstorm . . .	..	Roofs of a number of houses were blown off. Telegraph and telephone communications were disrupted and supply of electricity broke down.
Calcutta	29th May .	Afternoon	Thunderstorm	..	Wind speed during a squall reached 56 miles per hour and temperature fell by 20°F. Two persons were seriously injured by a collapsing wall. Air services were dislocated at Dum Dum. A cargo ship at Kidderpore docks went off her anchor as a result of the storm.
Delhi	29th May .	Noon .	Thunderstorm	..	Wind speed reached 58 miles per hour and temperature fell by 17°F. Power supply failed in some parts of the city. Several trees were uprooted. Only 3 cents of rain were recorded.
Baroda and adjoining areas .	3rd June .	Afternoon	Thunderstorm	..	A number of telegraph poles between Surat and Baroda were uprooted. Telegraph communication between Baroda and other parts of the country was affected.
Delhi	17th June .	Evening .	Duststorm.	..	Wind speed at one stage reached 62 miles per hour. Temperature fell by 7°F.
Delhi	25th September.	Evening	Duststorm . . .	..	Traffic in the city was paralysed for half an hour. Several trees were uprooted. Wind speed reached in squall was 42 miles per hour at Safdarjung. Temperature fell by 22°F.
Lucknow	26th September.	Afternoon	Dust and thunderstorm .	..	Squally weather in which wind speed reached 50-55 miles per hour, was followed by rain and hail. 2·1″ of rain fell in a short period and caused streets to be flooded. A number of persons were injured. 250 telephone connections and 3,000 electric connections were cut off. Over head power lines were also damaged in some places.

IV.—WINDS OF FORCE NINE OR MORE IN INDIAN SEAS

Excluding dates of storms and depressions, a description of which has been given above, winds of force 9 or more were recorded on ships in the Indian Seas during the year 1951 on the following occasions:—

Month and Date	Name of ship	Approximate position	
		Latitude °N.	Longitude °E
2nd June	S. S. Tomini	6·0	92·5
9th June	I. N. S. Ranjit	10·3	62·2
3rd July	S. S. Devon	12·1	58·7
23rd July	S. S. Parinja	9·4	52·9
23rd July	S. S. Parinja	9·6	52·6

PUBLICATIONS OF THE INDIA METEOROLOGICAL DEPARTMENT

(Complete list, upto January 1955, including those Publications which are now out of print.)

Notes:—

1. ALL THE PRICED PUBLICATIONS EXCEPTING THE DAILY, WEEKLY AND MONTHLY WEATHER REPORTS, AND THOSE ITEMS WHICH ARE 'OUT OF PRINT', ARE AVAILABLE FOR SALE WITH THE MANAGER OF PUBLICATIONS, CIVIL LINES, DELHI-8.
2. INDIAN DAILY WEATHER REPORT, WEEKLY WEATHER REPORT, AND MONTHLY WEATHER REPORT ARE AVAILABLE FOR SALE IN THE OFFICE OF THE DEPUTY DIRECTOR GENERAL OF OBSERVATORIES (FORECASTING) METEOROLOGICAL OFFICE, POONA-5.
3. DAILY REGIONAL WEATHER REPORTS FOR CALCUTTA, NEW DELHI, NAGPUR, BOMBAY AND MADRAS ARE AVAILABLE FOR SALE AT THE RESPECTIVE REGIONAL METEOROLOGICAL CENTRES.

I. GENERAL.—

Instructions to observers at the 2nd and 3rd class observatories, edition 3 (1943). Rs. 1-10 or 2*s.* 6*d.* *(Revised edition in press).	Departmental.
Cloud Atlas, edition 3 (1945). Rs. 2-2 or 3*s.* 6*d.**	Ditto.
Tables for the Reduction of Meteorological Observations in India, Reprint of 3rd edition (1947). Rs. 5-12.	Ditto.
Relative Humidity Tables (1937). As. 7 or 9*d.**	Ditto.
Hygrometric Tables (1000 mb.) edition 2 (1949). As. 14 or 1*s.* 3*d.*	Ditto.
Hygrometric Tables (900 mb.) edition 2 (1948). Rs. 1-14 or 2*s.* 9*d.*	Ditto
Hygrometric Tables (800 mb.) edition 2 (1949). Rs. 2-12 or 4*s.* 6*d.*	Ditto
Hygrometric Tables (700 mb.) 1944.	Ditto.
Hygrometric Tables, Vapour Pressure. Rs. 3-8 or 5*s.* 6*d.*	Ditto.
Saturation Temperature Tables (1942). As. 10.	K. N. Rao.
Rainfall Organisation (1929). As. 2.	Departmental.
Service Instructions for Part-time Observers (1952).	Ditto.
Instructions for making entries in Pocket Register and Monthly Meteorological Register (in press).	Ditto.
Weather Code (1955). [redacted]	Ditto.
Brief Weather Code (1949). Rs. 1-6 or 2*s.*	Ditto.
Aviation Weather Codes (1955). [redacted]	Ditto.
Codes for reporting upper Winds and Cloud Directions (1955). [redacted]	Ditto.
Code for Upper Air Reports (1955). [redacted]	Ditto.
Ships' Weather Code (1949). Rs. 1-10 or 2*s.* 6*d.*	Ditto.
Reports on the Meteorology of India for the years 1875—1890 (16 volumes). Each Rs. 10.†	Ditto.
Meteorology of the Bombay Presidency (1878).	C. Chambers.
Weather and the Indian Farmer (1946).	Departmental.
Meteorology in India.	Ditto.
Kodaikanal Observatory (1901—1951). Re. 1.	Ditto.

II. AVIATION METEOROLOGY.—

Meteorology for Airmen in India—	
Part I—General Meteorological features. Edition 2 (1949). Rs. 4-10 or 7*s.* 3*d.*	Ditto.
Part II—Climatology of Air Routes (1936).* Rs. 2-2 or 4*s.* 10*d.*	Ditto.
India's Climates—Summary for Airmen (1943). Re. 1 or 1*s.* 6*d.*	Ditto.
Meteorological Organisation for Airmen, M.O.A. pamphlet (1949).	Ditto.
Meteorological Conditions affecting aviation over the Northwest Frontier (1934). Rs. 1-8 or 2*s.* 6*d.*	R. G. Veryard and A. K. Roy.

III. ATLASES AND CHARTS.—

Climatological Atlas of India (1906).* Rs. 27.	Sir John Eliot.
Meteorological Atlas of the Indian seas and the North Indian Ocean (1908).* Rs. 13.	W. L. Dallas.
Monthly Weather Charts of the Bay of Bengal and adjacent sea north of the equator, showing mean pressure, winds and currents (1886).* Rs. 5.	H. F. Blanford.
Monthly Weather Charts of the Arabian Sea and the adjacent portion of the North Indian Ocean showing mean pressure, winds and currents (1888). Rs. 5.	Sir John Eliot.
Charts of Bay of Bengal and adjacent sea north of equator showing specific gravity, temperature and currents of the sea surface (1887). Rs. 1-8.	W. L. Dallas.
Daily Weather Reports and Charts of the Indian Monsoon Area for the Years 1893 to 1899, each month. Re. 1*.	Departmental.
Normal Weather and Pilot Charts of the Indian Monsoon Area for 8 a.m. for each month November 1900 to August 1908, each month. As. 4.*	Ditto.
Storm Tracks in the Bay of Bengal (1925). Rs. 3-6 or 5*s.* 9*d.**	C. W. B. Normand.
Storm Tracks in the Arabian Sea (1926). Rs. 3-8 or 6*s.**	Ditto.
Climatic Charts of India and Neighbourhood for Meteorologists and Airmen (1943).*	Departmental.
Climatological Atlas for Airmen (1943). Rs. 5-2 or 8*s.*	Ditto.
Climatological Charts of the Indian Monsoon Area (1945). Rs. 16 or 25*s.*	Ditto.

IV. CYCLONE MEMOIRS, ETC.—

Handbook of Cyclonic storms in the Bay of Bengal for use of Sailors—	
Vol. I—Text. 2nd edition (1900). Rs. 4.*	Sir John Eliot.
Vol. II—Plates. 2nd edition (1901). Rs. 1-8.*	Ditto.
Handbook of Cyclonic storms in the Bay of Bengal (Abridged) 1943. Re. 1.	Departmental.

Cyclone Memoirs—

Part I—Bay of Bengal Cyclone of May 20th to 28th, 1887 (1888). Re. 1.*	Ditto.
Part II—Bay of Bengal Cyclone of August 21st to 28th, 1888 (1890). Rs. 3.	Ditto.

* Out of print.

† Copies for the years 1875, 1876, 1878 to 1881, 1884, 1887, and 1890 are out of print.

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Part III—Bay of Bengal Cyclones of September 13th to 20th and October 27th to 31st, 1888, and Arabian Sea Cyclone of November 6th to 9th, 1888 (1890). Rs. 5.	Departmental.
Part IV—An enquiry into the nature and course of storms in the Arabian Sea and a catalogue and a brief history of all recorded storms in the Arabian Sea from 1848—1889 (1891). Rs. 3.	W. L. Dallas.
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Report of the Midnapore and Burdwan Cyclone of the 15th and 16th of October 1874 (1875). Rs. 3.*	W. G. Wilson.
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Report on the Madras Cyclone of May, 1877 (1879). Rs. 3.*	Ditto.
Winds, Weather and Currents on the coasts of India and the laws of storms, edition 2 (1942). Rs 2-2 or 3*s.* 6*d.*	Departmental.

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† Volumes for 1891, 1914 to 1924, 1932 to 1937 are out of print.

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(ii) Report on the administration of the Meteorological Department of the Government of India.
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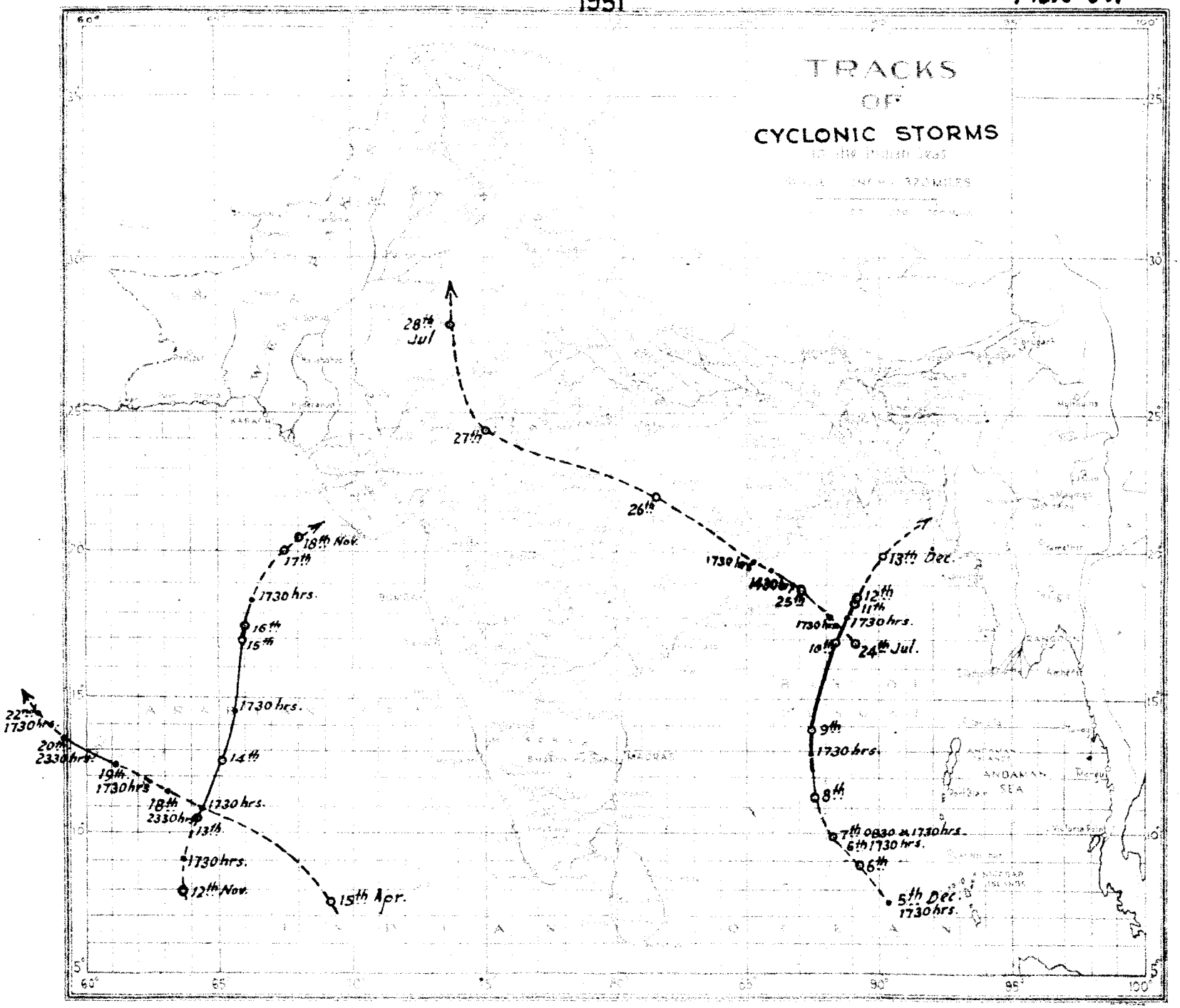

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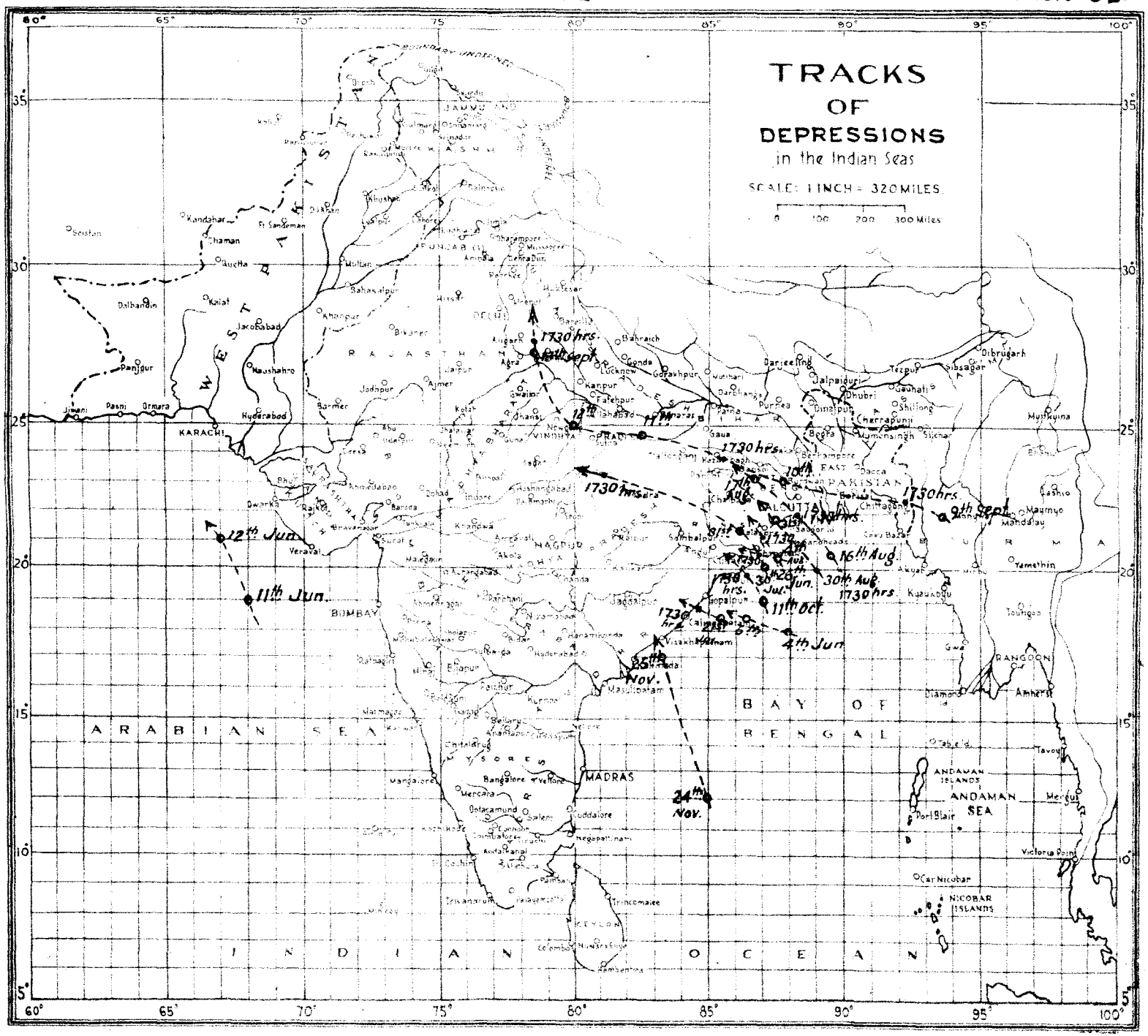

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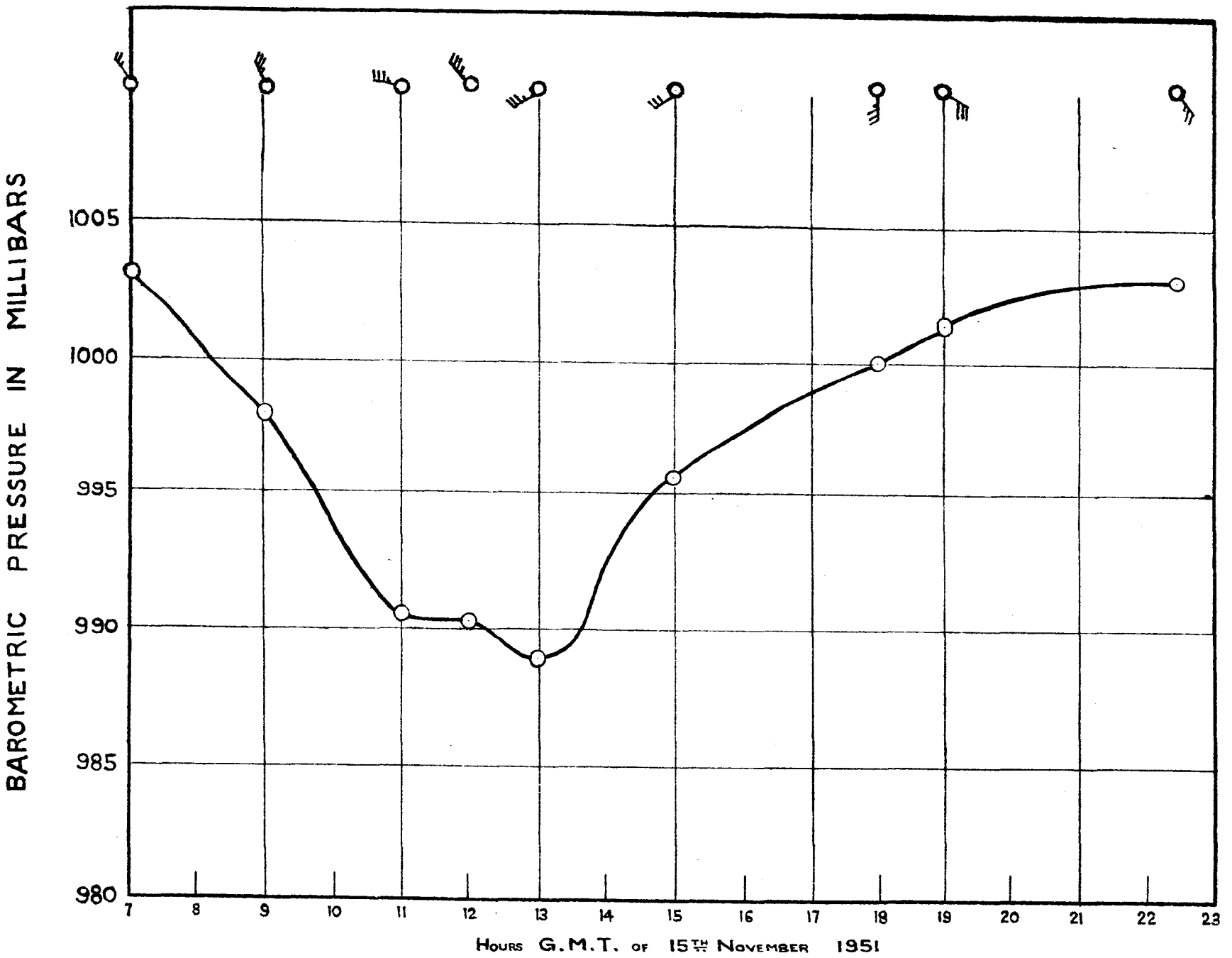

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FIG 1